Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

A99.9
F7644n
cop. 2

Research Note

USDA FOREST SERVICE INT-278
INTERMOUNTAIN FOREST & RANGE EXPERIMENT STATION
507-25th STREET, OGDEN, UTAH 84401

February 1980

A CONCEPTUAL FRAMEWORK FOR INTEGRATING FIRE CONSIDERATIONS IN WILDLAND PLANNING

Louis T. Egging[1]

Richard J. Barney[2]

Rita P. Thompson[3]

ABSTRACT

Offers a system for land management planning that enables managers to include and evaluate the effects of wildfire or prescribed burning on resources. Diagrams important considerations and decision-making steps.

KEYWORDS: Fire management, fire management planning, land use, land use planning, land management, land management planning, wildland management.

Wildfire is a force that affects all facets of resource management. It can be devastating to a resource management program or it can be beneficial and enhance productivity. Fire's effects on wildland resources are complex, but fire effects must be identified and evaluated by the manager or landowner when planning for management of the land.

We have previously developed a perspective of where fire fits in the general planning framework (Egging and Barney 1978). Fire is presented as one component to either use or exclude in meeting management objectives. It should be considered in evaluating the consequences of any proposed management action. We will now offer a system for integrating fire into planning.

---

[1] Formerly Research Industrial Engineer located at the Northern Forest Fire Laboratory, Missoula, Mont.; currently a private systems consultant and agricultural specialist.

[2] Team leader, planning team, Fire in Multiple Use Research Development Program, Northern Forest Fire Laboratory.

[3] Formerly located at the Northern Forest Fire Laboratory, Missoula, Mont.; currently a forest biologist and technical writer/editor in the land management planning group of the Lolo National Forest, Missoula, Mont.

A PLANNING PROCESS

Before we can integrate fire considerations into planning, we must have a common understanding of the planning process. The land has a certain potential for producing resources, and society has demands and desires for those resources. Land management planning helps the manager establish management direction that will balance resource potential and demand. Based on current and projected supply and demand, managers decide land allocations, use patterns, and procedures that will balance resource potential/demand.

The planning process begins with the situation assessment phase, which comprises three components. One component, focusing on the land area's physical and biological characteristics, determines the productive potential and suitability of a certain land for a specific use or mixes of uses. Existing information and supplemental inventories where needed are used to described the area's resources. The second component determines the landowner's demands and desire. In the case of Federal or State lands, the landowner is the public, and the appraisal process identifies how various publics feel about the way their lands are managed. Issue identification is a first step in any decision-making process and begins the process of public involvement.

Assessments of the physical/biological and the social/political situations appear in figure 1 as two lines proceeding from the start node, 0.

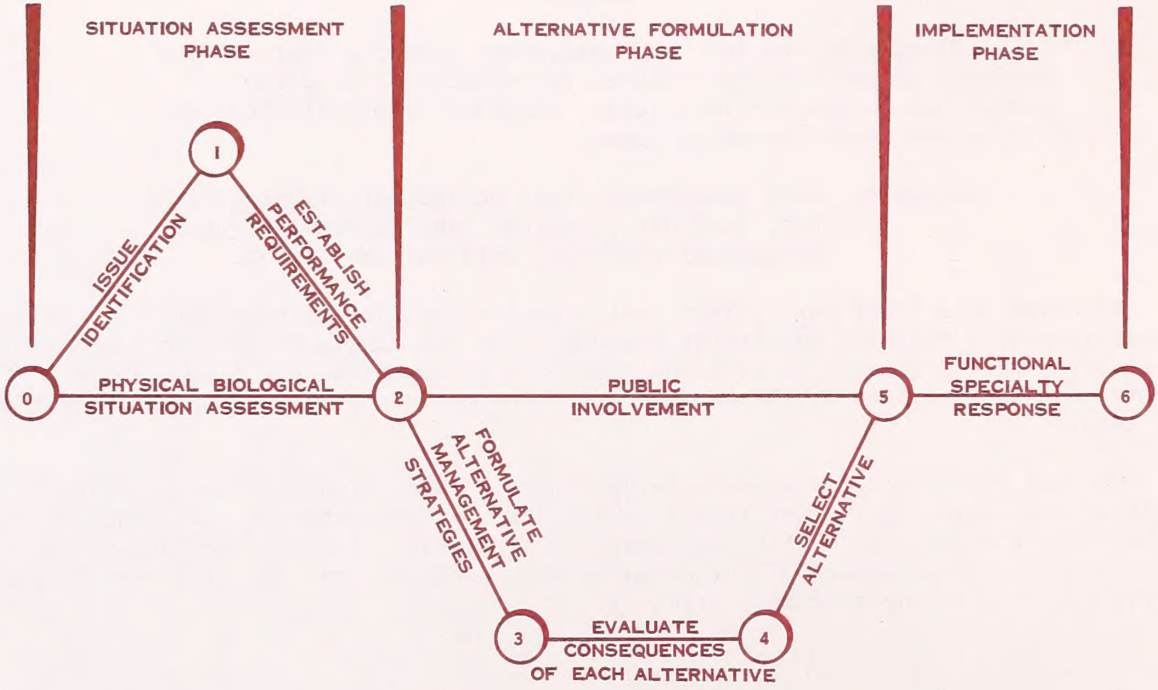
SITUATION ASSESSMENT PHASE
ALTERNATIVE FORMULATION PHASE
IMPLEMENTATION PHASE
1
ISSUE IDENTIFICATION
ESTABLISH PERFORMANCE REQUIREMENTS
0
PHYSICAL BIOLOGICAL SITUATION ASSESSMENT
2
PUBLIC INVOLVEMENT
5
FUNCTIONAL SPECIALTY RESPONSE
6
FORMULATE ALTERNATIVE MANAGEMENT STRATEGIES
SELECT ALTERNATIVE
3
EVALUATE CONSEQUENCES OF EACH ALTERNATIVE
4

Figure 1.--The general planning process.

In the third component of the situation assessment phase, criteria are established for the planning effort. Criteria are standards, or "rules of the game" that guide trade-offs made throughout the process. They take the form of policy statements; agency goals; needs and demands of local, regional, and national publics; monetary and manpower constraints; and traditional uses.

As portrayed in figure 1, the next phase of planning, beginning at node 2, deals with alternative formulation. A spectrum of management strategies[4] is developed, based on professional judgments about the resource situation and the public's concerns about resource use.

The consequences of employing any management strategy are evaluated in terms of the planning criteria established, and the physical, biological, and economic effects projected over time. Comparing the consequences of alternative management strategies, generally in terms of trade-offs between levels of resource use and values, leads to the selection of the "best" alternative. The public must be kept informed of and involved in the processes used to formulate, evalute, and select any alternative.

After a management alternative is selected, each functional specialty responds by developing a program of work which, when budgeted, becomes the basis for on-the-ground activities that implement the management alternative. This process begins at node 5 in figure 1 and is identified as the implementation phase of the planning process.

FIRE CONSIDERATIONS IN PLANNING

The purpose of including fire considerations in the planning process is to ensure that fire-related decisions are responsive to the management direction established by planning. Depending on the circumstances of its occurrence, fire as a force can both further and preclude the attainment of resource management goals. Therefore, certain types of fire information need to be compiled in the situation assessment phase of planning as part of the physical/biological appraisal process. As a minimum, fire occurrence, fire weather, fire history, and fuels information are gathered. This information is used to stratify areas of fire hazard and potential risk within the planning area.

The fire hazard/risk stratification provides the base information for fire consideration in the alternative formulation phase of planning the process. For each management strategy developed, the hazard/risk stratification and resource management objectives are analyzed and a range of fire management strategies developed. These strategies consider feasible levels of fire control and fire use consistent with the resource potential/demand issue being addressed.

As alternative management strategies are evaluated and compared as to their effects over time, so too are the fire management strategies. The effects of various levels of fire control and use are projected in terms of resource outputs and environmental and economic consequences. An evaluation of effects relative to criteria established earlier in the process facilitates comparing alternatives and the eventual selection of the management alternative to be implemented. Thus, the alternative selected for implementation includes a fire control/fire use strategy to be applied on the area that is responsive to resource management objectives, established criteria, and economic sideboards.

---

[4] A management strategy, as used here, refers to a procedure employed to reach a solution to a resource potential/demand problem or issue.

The PERT diagram of planning process, figure 1, is expanded in figure 2 to detail and highlight the fire considerations described above. Nodes 0, 2, 3, 4, and 6 correspond to the same numbered nodes in figure 1.

A FIRE MANAGEMENT DECISION SYSTEM

The overview of a planning process, and basic fire considerations in that process, provide a foundation for developing a responsive fire control/fire use strategy. Fundamental to integrating fire considerations and planning is the ability to project the consequences of a proposed fire strategy on the ecosystem over time. Comparing and evaluating these consequences are key to making the final management decision.

Fire is a force that produces significant effects on the environment. Primary effects on the airshed, soils, and vegetation secondarily affect watershed, wildlife, and the visual quality of an area. Fire can either enhance or degrade site productivity depending on conditions of the burn. It is multifaceted in its effects, both immediately and extended over time. Planners and land managers alike need to consider the full spectrum of fire effects and the effects of alternative fire strategies when making land allocation and resource management decisions.

Because of its complexity as a force and its effects on ecosystems, fire demands a holistic evaluation. The planning system must have the capability to project the effects of fire on all resources over time, to help the manager make specific fire decisions in planning. Such a system is diagrammed in figure 3. Starting with a proposed fire control/fire use strategy to be evaluated, information flows through an estimation of fire behavior, fire effects, and an economic evaluation of consequences. Applying this system to several strategies, the "best" strategy in terms of responsiveness to resource management objectives and planning criteria can be selected for implementation.

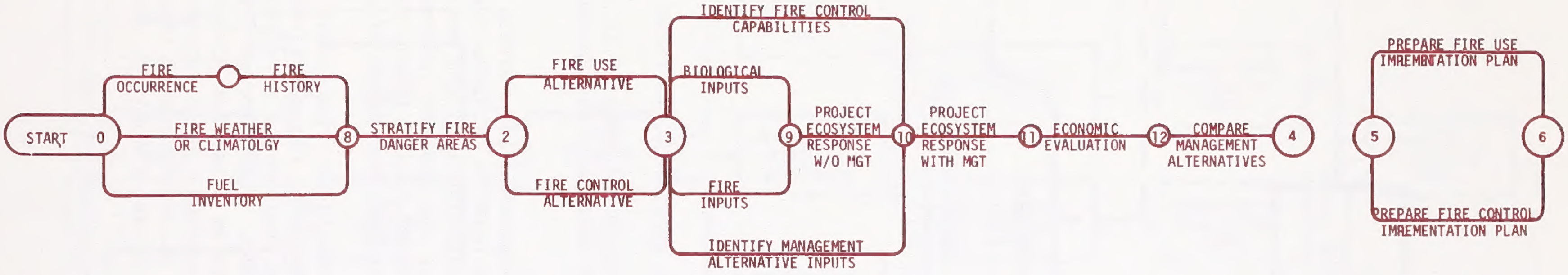
START
0
FIRE OCCURRENCE
FIRE HISTORY
FIRE WEATHER OR CLIMATOLGY
FUEL INVENTORY
8
STRATIFY FIRE DANGER AREAS
2
FIRE USE ALTERNATIVE
FIRE CONTROL ALTERNATIVE
3
IDENTIFY FIRE CONTROL CAPABILITIES
BIOLOGICAL INPUTS
FIRE INPUTS
IDENTIFY MANAGEMENT ALTERNATIVE INPUTS
9
PROJECT ECOSYSTEM RESPONSE W/O MGT
10
PROJECT ECOSYSTEM RESPONSE WITH MGT
11
ECONOMIC EVALUATION
12
COMPARE MANAGEMENT ALTERNATIVES
4
5
PREPARE FIRE USE IMREMENTATION PLAN
PREPARE FIRE CONTROL IMREMENTATION PLAN
6

Figure 2.--Fire considerations in planning.

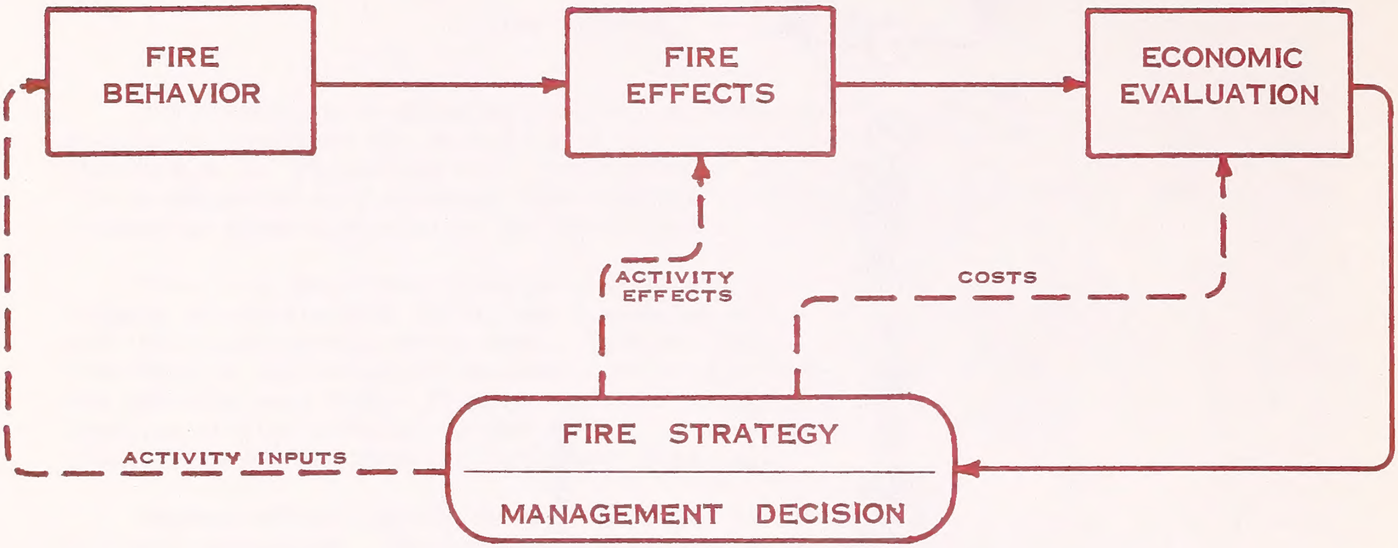

Figure 3.--Information flow for fire management decision system.

The model of a fire management decision system in figure 3 is expanded in figure 4 to show information requirements for the fire behavior, fire effects, and economic evaluation subsystems.

The fire behavior subsystem requires site-specific information on topography, vegetation, weather, and fuels. These data are used to describe the fuels situation in terms of its physical properties (size and distribution) and moisture content. Combining the fuels information with topographic and weather information , models are developed to predict fire behavior (Rothermel 1972; Albini 1976). Fire behavior predictions are in terms of fire intensity, duration, and rates of spread.

Information from the fire behavior subsystem flows to the fire effects subsystem to predict the effects of a fire of certain behavioral characteristics on the resource of an area. The fire effects subsystem has two phases--the prediction of primary effects and the prediction of long-term responses. Immediate or primary effects on soils, vegetation, and air quality are inputs to an ecosystem production module, where these effects are in terms of their long-term consequnces on resource productivity. Primary fire effects information also flows to an environmental response module where interpretations of long-term, off-site effects on water quality, smoke production, and soil erosion are made.

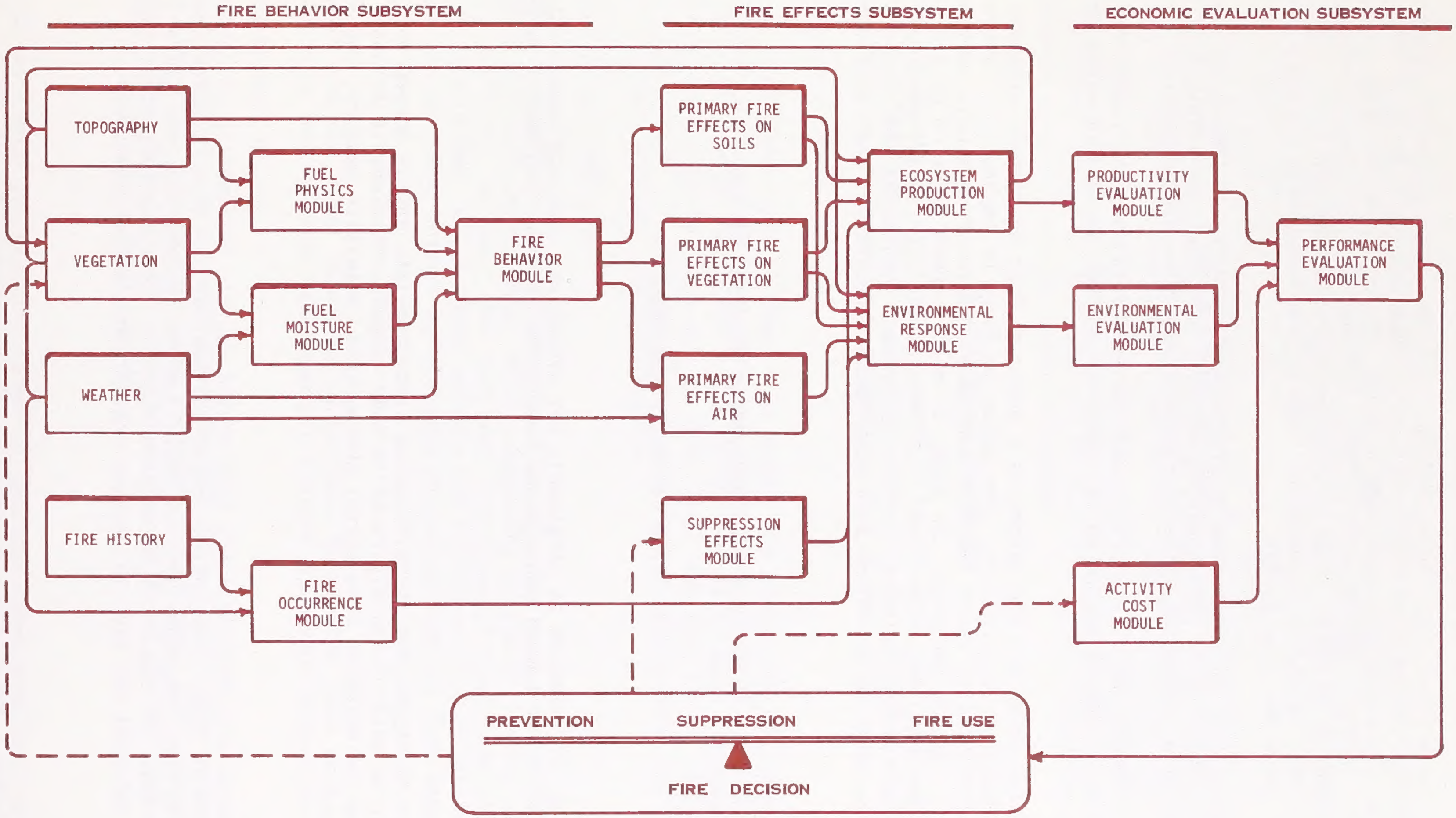
FIRE BEHAVIOR SUBSYSTEM
FIRE EFFECTS SUBSYSTEM
ECONOMIC EVALUATION SUBSYSTEM
TOPOGRAPHY
VEGETATION
WEATHER
FIRE HISTORY
FUEL PHYSICS MODULE
FUEL MOISTURE MODULE
FIRE OCCURRENCE MODULE
FIRE BEHAVIOR MODULE
PRIMARY FIRE EFFECTS ON SOILS
PRIMARY FIRE EFFECTS ON VEGETATION
PRIMARY FIRE EFFECTS ON AIR
SUPPRESSION EFFECTS MODULE
ECOSYSTEM PRODUCTION MODULE
ENVIRONMENTAL RESPONSE MODULE
PRODUCTIVITY EVALUATION MODULE
ENVIRONMENTAL EVALUATION MODULE
ACTIVITY COST MODULE
PERFORMANCE EVALUATION MODULE
PREVENTION
SUPPRESSION
FIRE USE
FIRE DECISION

Figure 4.--Fire management decision system.

Long-term fire effects are evaluated from a broad scale economic perspective in the final subsystem of the fire decision system. Changes in resource productivity, derived from interpreting long-term fire effects, are evaluated relative to their social and environmental consequences. These consequences are then tested against the established planning criteria. This evaluation combined with the cost of fire control/fire use activities required to implement a given fire management strategy provides the basis for comparing strategies.

The ultimate fire decision made in the planning process is the selection of the strategy most responsive to management objectives. The strategy likely will be some combination of fire prevention, fire suppression, and fire use activities.

A general example will help illustrate how to obtain the data needed for the fire management decision system portrayed in figure 4, and how the system might be used in a planning situation.

The starting point for the system is a proposed fire management strategy developed for a given management alternative. One point needs to be emphasized: *There must be a management objective to which the fire management decision made will respond.* Fire management is a support function. As such, it must respond to or be pulled along by management objectives, not drive them. Each management alternative developed in the planning process can have an array of fire management strategies that respond to it. The one or more selected are those fire management alternatives that best meet planning criteria.

USING THE FIRE MANAGEMENT DECISION SYSTEM

Fire Behavior Subsystem

TOPOGRAPHY

Topographic information is obtainable for almost any resource management unit from topographic maps, aerial photographs, satellite imagery, and on-the-ground reconnaissance.

VEGETATION

Some type of vegetation stratification already exists and is mapped for many land areas, and may be entered and digitized in some computer-retrievable format. Vegetation information may be obtained from aerial photographs, satellite imagery, and field reconnaissance.

WEATHER

Most Federal and State agencies have stored weather information in computer form for some period of time. The United States Weather Service also archives weather information for many locations in both daily surface observations and climatic summaries. Some of these data are available on written request. Computer compatible tapes or cards can be obtained and used to produce weather information summaries.

FIRE HISTORY

Almost all land management agencies in the country utilize some form of wildfire activity reporting. These data are variously retrievable--some on computer tape, others in office files. In addition, there are several techniques that can be used in the field to determine fire periodicity within a management unit (Arno 1977).

An important point to remember when compiling data to use in information flow models, such as the one described here, is that output from one module becomes input for the next. Input requirements dicate the kind of information to be collected and summarized. The base-type information described above is available at various levels of resolution. The level of planning for which a decision system is being used dictates the resolution. Project level planning requires more precise information than land allocation planning.

The four categories of data mentioned thus far are needed for the fire behavior subsystem of the decision system and provide input for the fuel physics, fuel moisture, and fire occurrence modules. The fuel physics and fuel moisture modules are related to available fire behavior prediction systems. By combining topography, vegetation, weather, the physical characteristics of fuels and fuel moisture yields a fire behavior system closely related to the fire danger rating system (Deeming and others 1978). The fire occurrence module is a tabulation of fire occurrences over time, frequently with a probability of occurrence factor developed.

Fire Effects Subsystem

As seen in figure 4, the outputs generated in the fire behavior module provide initial input to the fire effects subsystem, because a fire's effect on an ecosystem depends primarily on the behavioral characteristics of that fire.

PRIMARY EFFECTS ON SOILS

Factors considered here include: the amount and extent of duff removal; changes in the physical characteristics of the soil, especially its ability to absorb moisture; soil productivity, or the fertility regime as influenced by fire. Effects may be either beneficial or adverse, and will be both short and long term. Figure 4 shows that interpretations of the primary effects of a fire on soils feed into the ecosystem production and environmental response modules.

PRIMARY EFFECTS ON VEGETATION

Effects on vegetation include consideration of: how much vegetation will be burned and in what sort of pattern; which components of the vegetation will be affected--understory, overstory, or both; how much and what types of vegetation will be killed, scorched, or unaffected. All of these effects are functions of fire intensity, duration, rate of spread, and total extent--information generated from the fire behavior module.

AIR QUALITY

The main concern is the amount of particulate that a fire will emit. Output of the fire behavior module helps determine particulate and smoke production.

SUPPRESSION EFFECTS MODULE

A major consideration is determining how effective suppression action can or will be given a fire start in a certain area. Weather, topography, fuel characteristics, vegetation, access, manpower, past activity in the area--all are involved in deriving an estimate of suppression effectiveness.

ECOSYSTEM PRODUCTION MODULE

This "box" is one of two collector modules in the fire effects subsystem. Information gathered and interpretations made on fire behavior and fire effects are used to determine whether the flow of products (commodities and amenities) from an ecosystem will increase, decrease, or be unchanged. The rate and duration of changes in production flow are also determined. Note that outputs of the ecosystem production module feed back to the vegetation module of the fire behavior subsystem. The process diagrammed in figure 4 is repetitive. Whenever there is a change in any component of an ecosystem, the change is manifest throughout the system. Further, the influence or relationship of that one component on the rest of the system changes also.

ENVIRONMENTAL RESPONSE MODULE

The other collector module, environmental response, represents the place in the decision system where social perceptions of the fire-caused change in the area are documented. Visual quality, water quality, and air quality are examples of the factors considered.

ECONOMIC RESPONSE MODULE

Planning and decision making finally start to happen in this final segment of the fire management decision system. Changes recorded are analyzed and evaluated. The productivity evaluation module assesses changes in resource products--animal unit months of deer, elk, livestock use; board feet of sawtimber; acre feet of water; recreation visitor days--relative to the ecosystem's change over time as a response to fire's influence. Changes in quality perception are likewise evaluated in the environmental evaluation module.

PERFORMANCE EVALUATION MODULE

At this stage, all the predicted and potential changes in an ecosystem stemming from a fire management strategy are weighed against the established planning criteria. If changes meet the criteria, the fire management strategy might be selected for implementation; if not, the strategy could be modified and run through the system again. Note that the activity cost module plugs into that segment of the decision system. All aspects of developing a fire management strategy--hazard reduction, suppression action, prescribed burning, area inventory and reconnaissance--have an associated cost. The cost of a specific activity needs to be evaluated in terms of the changes in and response of the ecosystem relative to management objectives and criteria. As mentioned earlier, management objectives are the driving force in this decision system. The reason for having a fire management decision system is to test a decision's responsiveness to a management objective, both immediately and over time.

SUMMARY

In planning for the management of our wildland resources, fire is one factor that is often overlooked. Fire can significantly affect resource production. It can be either devastating to or supportive of a planned management strategy. Likewise, a management strategy, when implemented, can change the fire situation. To integrate fire and planning, fire considerations must be woven throughout the whole process.

The planning process is viewed as a primary ingredient in the decision-making process. This process is PERT, charted in a general form, then made more specific with fire considerations included.

An important consideration in integrating fire and planning is projecting and evaluating the consequences of fire management strategy in terms of resource response over extended time periods. This segment is diagrammed as the fire management decision system, consisting of three segments--fire behavior, fire effects, and economic evaluation. By utilizing the planning model and fire decision system to help analyze management strategies, the resource planner will be able to make decisions that put fire management strategies into perspective relative to resource management goals. Then fire management will become more responsive to overall resource management.

PUBLICATIONS CITED

Albini, Frank A.
1976. Estimating wildfire behavior and effects. USDA For. Serv. Gen. Tech. Rep. INT-30, 92 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.
Arno, Stephen F., and Kathy M. Sneck.
1977. A method for determining fire history in coniferous forests in the Mountain West. USDA For. Serv. Gen. Tech. Rep. INT-42, 28 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.
Deeming, John E., Robert E. Burgan, and Jack D. Cohen
1978. The national fire-danger rating system. USDA For. Serv. Gen. Tech. Rep. INT-39, 63 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.
Egging, Louis T., and Richard J. Barney.
1978. Fire management: a component of land management planning. Environ. Manage. 3(1):15-20.
Rothermel, Richard C.
1972. A mathematical model for predicting fire spread in wildland fuels. USDA For. Serv. Res. Pap. INT-115, 40 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1979-0-677-121/93

The Intermountain Station, headquartered in Ogden, Utah, is one of eight regional experiment stations charged with providing scientific knowledge to help resource managers meet human needs and protect forest and range ecosystems.

The Intermountain Station includes the States of Montana, Idaho, Utah, Nevada, and western Wyoming. About 273 million acres, or 85 percent, of the land area in the Station territory are classified as forest and rangeland. These lands include grasslands, deserts, shrublands, alpine areas, and well-stocked forests. They supply fiber for forest industries; minerals for energy and industrial development; and water for domestic and industrial consumption. They also provide recreation opportunities for millions of visitors each year.

Field programs and research work units of the Station are maintained in:

Boise, Idaho

Bozeman, Montana (in cooperation with Montana State University)

Logan, Utah (in cooperation with Utah State University)

Missoula, Montana (in cooperation with the University of Montana)

Moscow, Idaho (in cooperation with the University of Idaho)

Provo, Utah (in cooperation with Brigham Young University)

Reno, Nevada (in cooperation with the University of Nevada)

U.S.D.A.
NAT'L AGRIC LIBRARY
RECEIVED
APR 4 '80
PROCUREMENT SECTION
CURRENT SERIAL RECORDS